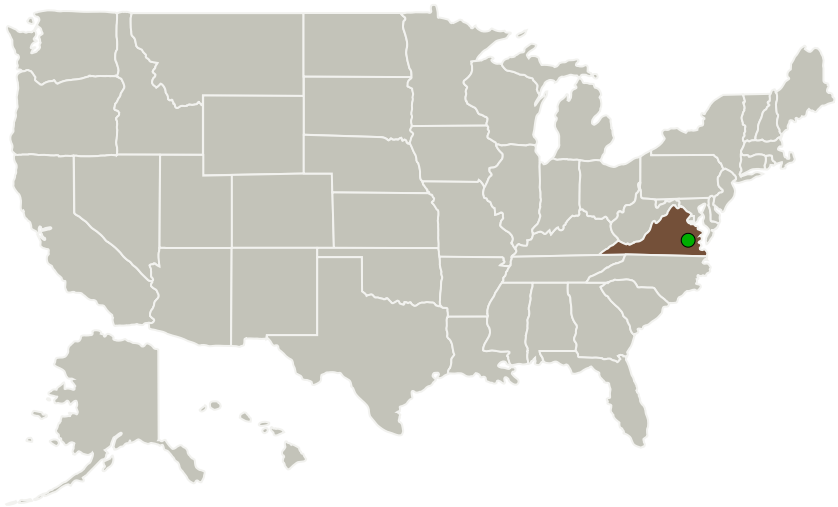
Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures, Phase I

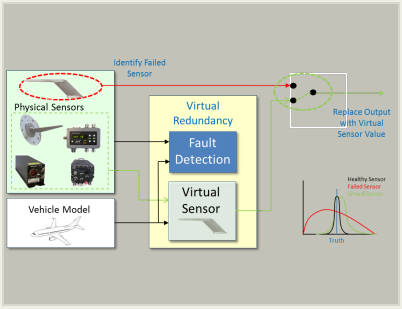
Completed Technology Project (2014 - 2014)

Project Introduction

Both autopilot systems and human pilots, particularly human pilots operating in instrument meteorological conditions, rely heavily on sensor feedback to safely control aircraft. The loss of reliable information for even a single state feedback signal can easily initiate a chain of events that leads to an accident. Even when hardware redundancy is employed, common-mode failures are a significant hazard that can make hardware redundancy ineffective for achieving the desired system reliability. For example, multiple pitot tubes can experience a common-mode failure during an icing event, depriving the pilot of vital airspeed information. The proposed virtual redundancy approach can significantly improve flight safety by identifying failed sensors and estimating the correct output values as replacements for those failed sensors. Estimates are based on a rigorous statistical formulation that makes optimal use of all available information including feedback from all remaining physical sensors, nonlinear models of vehicle dynamics, and models of actuator and sensor responses. The proposed research will also develop strategies for enabling pilots to make effective use of the virtual sensor outputs, including guidance algorithms that identify a trajectory that maximizes the likelihood of maintaining safety of flight and cueing techniques that allow the pilot to follow the resulting trajectory while minimizing the increase in workload.

Primary U.S. Work Locations and Key Partners





Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures Project Image

Table of Contents

Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures, Phase I

Completed Technology Project (2014 - 2014)

Organizations Performing Work	Role	Type	Location
Barron Associates, Inc.	Lead Organization	Industry	Charlottesville, Virginia
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Virginia

Project Transitions

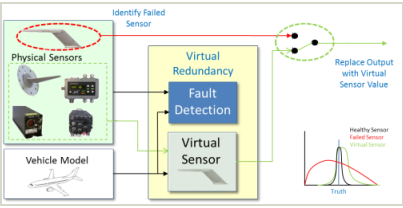
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140492)*

Images



Project Image
Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures Project Image *(https://techport.nasa.gov/image/128617)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Barron Associates, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Richard Adams

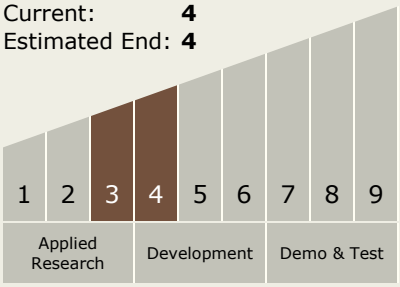
Co-Investigator:
Alec Bateman

Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures, Phase I

Completed Technology Project (2014 - 2014)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX16 Air Traffic Management and Range Tracking Systems
  - TX16.3 Traffic Management Concepts

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System